

PATENT CLAIMS

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1. Substrate for packaging of or for attachment to products which are sensitive to aging and temperature, having a time-temperature integrator arranged in the region of the substrate, characterised in that the time-temperature integrator contains a matrix and at least one reversible indicator embedded therein, which has photochromic properties on the basis of transfer reactions.
2. Substrate according to claim 1, characterised in that the substrate is a packaging material.
3. Substrate according to claim 1 or 2, characterised in that the transfer reactions are based on the transfer of charged or uncharged hydrogen atoms or hydrogen isotopes.
4. Substrate according to one of the preceding claims, characterised in that the reversible indicator has a skeletal structure according to the general formula I:

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(Formula page 2 of claims)

wherein A₁ – A₅

= carbon atom and/or a heteroatom, such as for example N, S, O

R₁ – R₄

= hydrogen atom and/or an isotope thereof, and/or Cl, F, Br or a substituent, such as for example alkyl groups, in particular methyl groups or aryl groups, in particular phenyl groups.

R₅

= H, D or T or a substituent, such as for example Cl, F, Br or an alkyl group, in particular methyl group or an aryl group, in particular phenyl or pyridine, and

R₆

= H, D, T

B₁ – B₇

= carbon atom and/or a heteroatom, such as for example N, S, O.

R₁ – R₁₀

= hydrogen atom and/or an isotope thereof, and/or one or more Cl, F, Br, amino groups or nitro groups or one or more substituents, such as for example alkyl groups, in particular methyl or aryl groups, in particular phenyl, and

R₁₁

= nitro group or a cyano group or a carboxylic acid group or a variant, such as for example an ester, amide, ketone or aldehyde group.

Substance

5. Substrate according to one of the preceding claims, characterised in that the reversible indicator has a skeletal structure according to the general formula II:

(Formula page 3 of claims)

wherein A₁ - A₁₂ = carbon atom and/or a heteroatom, (such as for example N, S, O.)

R₁ - R₇ = hydrogen atom and/or an isotope thereof, and/ or Cl, F, B or other substituents, (such as for example alkyl groups, in particular methyl or aryl groups, in particular phenyl.)

R₈ = H, D, T or a substituent, (such as for example Cl, F, Br or an alkyl group, in particular methyl or an aryl group, in particular phenyl or pyridine.)

R₉ = H, D, T

B₁ - B₇ = carbon atom and/or heteroatom (such as for example N, S, O.)

$R_{10} - R_{13}$ = hydrogen atom and/or an isotope thereof, and/or one or more Cl, F, Br, amino groups or nitro groups, or one or more substituents, (such as alkyl groups, in particular methyl or aryl groups, in particular phenyl.)

R_{14} = nitro group or a cyano group or a carboxylic acid group or a variant, such as for example an ester, amide, ketone or aldehyde group.)

6. Substrate according to one of claims 4 or 5, characterised in that in the general formula I and II, $R_4 = NO_2$ and 2 – 4 NO_2 groups are present.
7. Substrate according to claim 1 or 2, characterised in that the transfer reactions are based on large, charged or uncharged groups.
8. Substrate according to claim 1 or 2, characterised in that the transfer reactions are based on a charged or uncharged halogen atom.
9. Substrate according to one of the preceding claims, characterised in that the reversible indicator has more than one characteristic time domain.
10. Substrate according to one of the preceding claims, characterised in that at least two reversible indicators having different characteristic time domains are embedded in the matrix.
11. Substrate according to one of the preceding claims, characterised in that the reversible indicator has photo-induced colouration.
12. Substrate according to one of the preceding claims, characterised in that at least one irreversible indicator having photochromic properties is arranged in the region of the reversible indicator.

Sub B13

13. Substrate according to one of the preceding claims, characterised in that the time-temperature integrator has a filter which is impermeable to light, which effects photo-induced colouration of the reversible indicator.

Sub B13 T1D

14. Substrate according to claim 13, characterised in that the filter is impermeable in the wavelength range of a wavelength preferably below 430 nm.

Sub B14 T1D

15. Substrate according to one of the preceding claims, characterised in that the substrate includes a reference scale arranged in the region of the time-temperature integrator.

Sub B15 T1D

16. Substrate according to one of the preceding claims, characterised in that the matrix is a polymer film.

Sub B16 T1D

17. Substrate according to one of the preceding claims, characterised in that the substrate is a polymer film.

Sub B17 T1D

18. Substrate according to one of the preceding claims, characterised in that a substrate region forms the matrix for the reversible indicator.

Sub B18 T1D

19. Process for determination of quality of products which are sensitive to aging and temperature and are provided with a substrate according to one of claims 1 to 18, containing the steps:

a) photo-induced colouration of the reversible indicator; and

b) determination of the degree of time-related or temperature-related discolouration and the quality of the product taking into account the degree of discolouration.

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20. Process according to claim 19, characterised in that the determination of the quality of the product is effected by evaluating the degree of discolouration with the aid of the reference scale.

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21. Process according to claim 19 or 20, characterised in that the irreversible indicator is applied after optically induced colouration of the reversible indicator.

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22. Process according to one of claims 19 to 21, characterised in that the filter is applied after optically induced colouration.

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23. Process according to one of claims 19 to 22, characterised in that the optically induced colouration of the reversible indicator is effected by UV or near UV light.

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24. Process according to one of claims 19 to 23, characterised in that the optical activation of the time-temperature integrator is effected by irradiation of the side of the time-temperature integrator opposite the filter.)

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